



# WELCOME

# ETHANOL Awareness

Traffic Incident Management Task Force

November 8, 2011





# ETHANOL

Massachusetts:

2-3 times a week 6+ Million Gallons Transported by  
Rail-Barge-Trucks

Ethanol Trains Impact 88 Massachusetts Communities

## WHY ARE WE HERE ?

The sky is not falling but

## ARE WE PREPARED ?

Now the largest volume of hazardous material shipped by rail

Public Safety and Fire Control Challenges

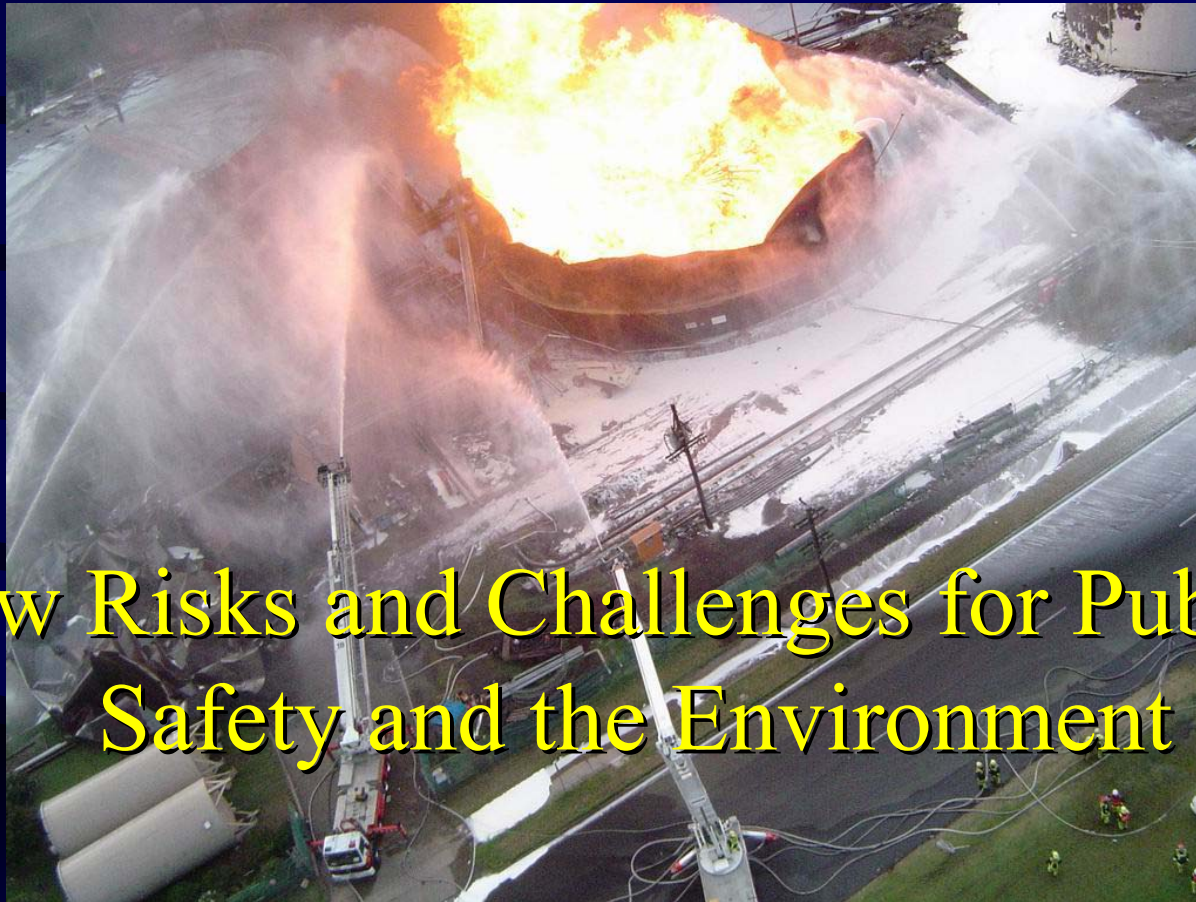
2010 Production in the United States - 13 billion gallons

20,000,000 Gallons Stored Locally





# ETHANOL



## New Risks and Challenges for Public Safety and the Environment

Presented by: Massachusetts Firefighting Academy Division  
Special Hazards Training Branch  
Hazardous Materials & Flammable Gas Training Groups



# What is Ethanol?

A colorless volatile flammable liquid  $C_2H_5OH$  that is the intoxicating agent in liquors and is also used as a solvent and in fuel —called also *ethyl alcohol*, *grain alcohol*

Source: Merriam-Webster.com





# What is Denatured Ethanol?

Ethanol with additives that make it unsuitable for drinking.

Used as Gasoline Additives





# Ethanol History & Need





# Ethanol History & Need

## Late 1970's

- Gasoline additive since late 1970s
  - MTBE- (Methyl Tertiary Butyl Ether)
- Primary role was octane enhancer until late 1980s:
  - Viewed as environmentally sound alternative to use of lead in gasoline





# Ethanol History & Need

## Late 1980's

➤ Late 1980s:

- Mandatory oxygenated fuel programs
- Some states used ethanol / oxygenates to lower CO emissions





# Ethanol History & Need

Late 1980's

- Ethanol is currently most widely used to raise the octane:
  - Replaced MTBE banned in most states (carcinogen)  
(Methyl Tertiary Butyl Ether)



Source: EERC/IAFC/RFA



# Ethanol History & Need

- Used today in Flex Fuel E85, an alternative fuel blend based on a renewable source.





# Chemical and Physical Characteristics

## Ethanol and Hydrocarbon Fuels

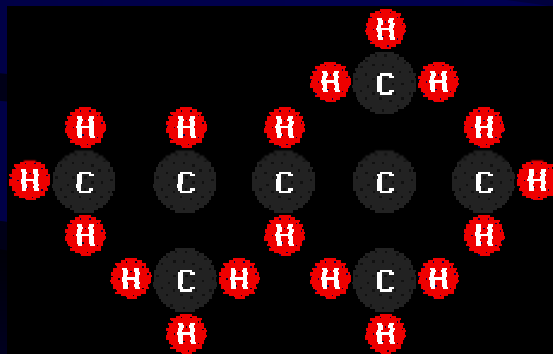
What's the Difference?



# Hydrocarbons & Ethanol Blends

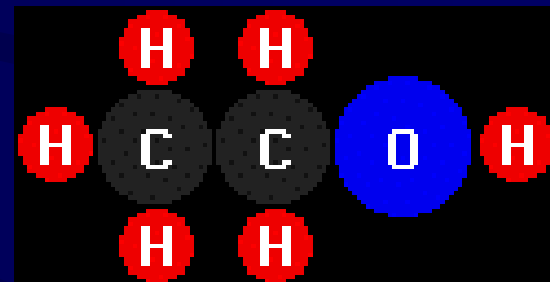
## What's the Difference?

Gasoline-IsoOctane C<sub>8</sub> H<sub>18</sub>



Source: [altfuels.org](http://altfuels.org)

Ethanol C<sub>2</sub> H<sub>5</sub> OH



Source: [altfuels.org](http://altfuels.org)



# Characteristics of Gasoline (Hydrocarbon)

**Gasoline's Greatest hazard is flammability:**

LEL is 1.4 % and UEL is 7.6 %



# Characteristics of Ethanol (Polar Solvent)



**Ethanol's Greatest hazard is flammability:**

(LEL is 3.3 % and UEL is 19 %)



# Ethanol

## Greatest Hazards

- Its Flammability
- Transloading Operations
  - Conducts Electricity
    - Electrocution Hazards
    - Ignition Sources
    - Static Electricity

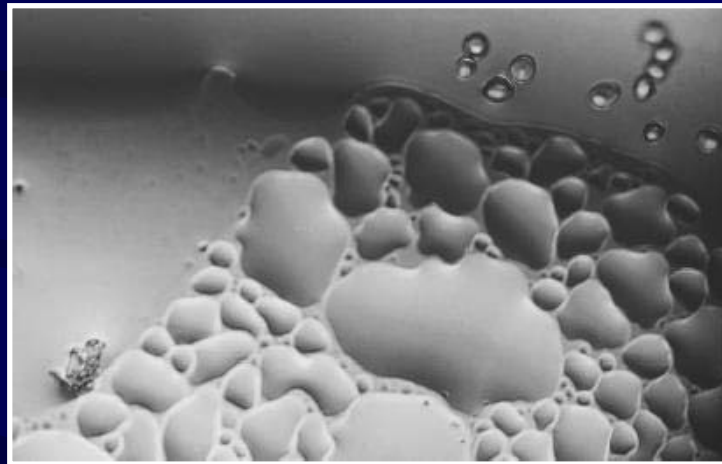


Source: MassDEP MassDFS

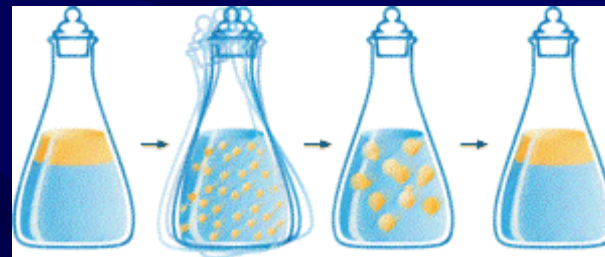




# Water Solubility Gasoline



Non-Soluble in water





# Water Solubility Ethanol

- Ethanol is miscible in water soluble at any concentration. [www.differencebetween.net](http://www.differencebetween.net)

Dilution may not be a solution

1000 gallons of ethanol needs 4000-5000 gallons of water to dilute.

Where does runoff go?

Where does burn-off go??





# Ethanol (A Polar Solvent)

**What is a Polar Solvent ?  
Alcohol-Acetone-MEK**

**Simply put, it mixes with the most popular solvent:  
WATER**










# Common Ethanol Blended Fuels

## ➤ 3 common ethanol-blended fuels:

- E-10 (most common)
- E-85
- E-95

## ➤ Pure Ethanol

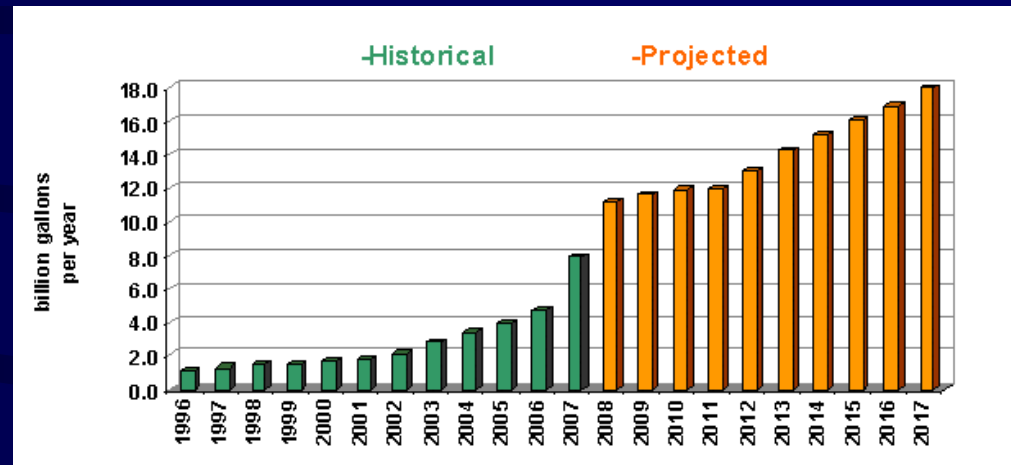
- E-100

E10		
E85		
E95		OR 
E100		



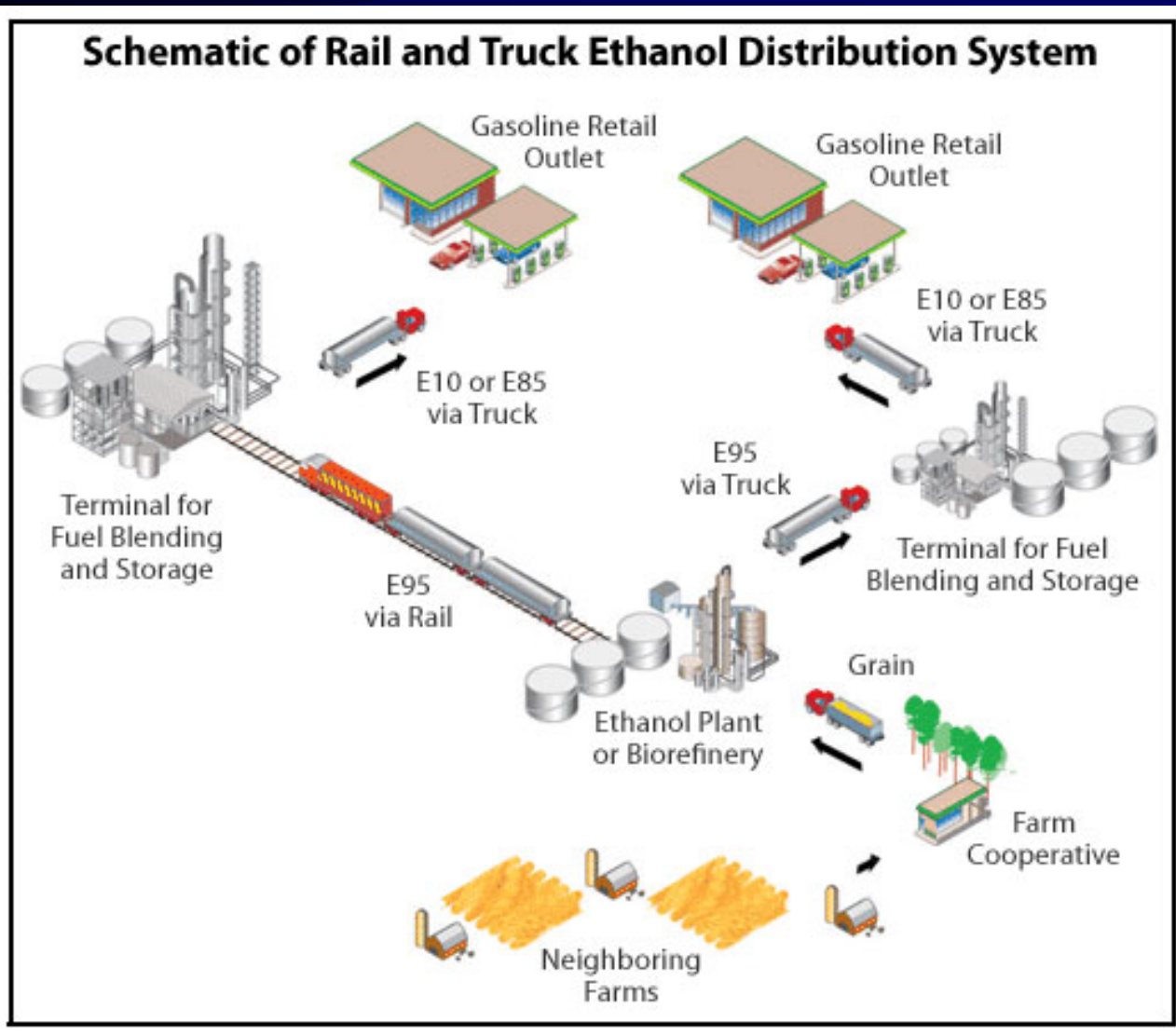
# The Risks

- The fastest growing commodity in transportation
- Polar Flammable Liquid
- Requires unusual fire fighting equipment and tactics
- Unique environmental impacts when released



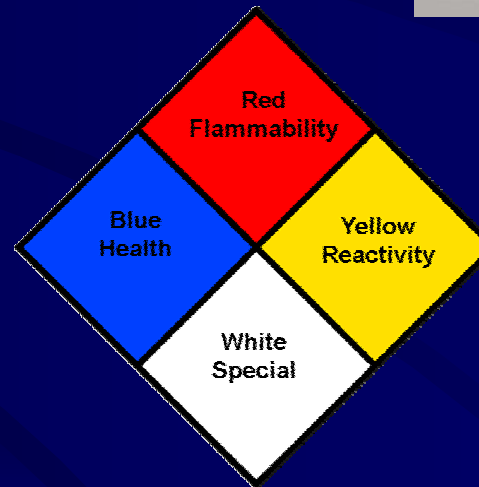
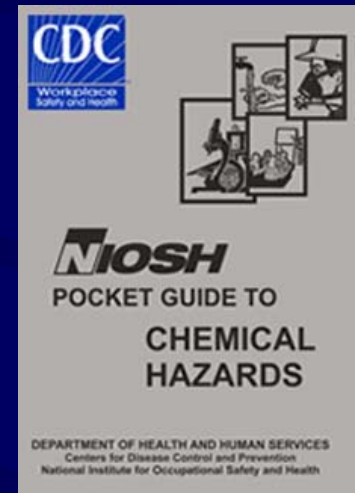
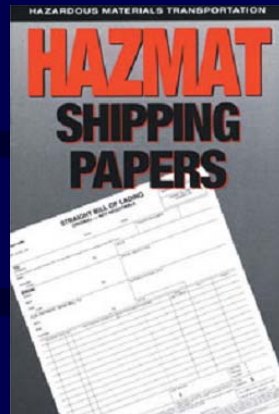
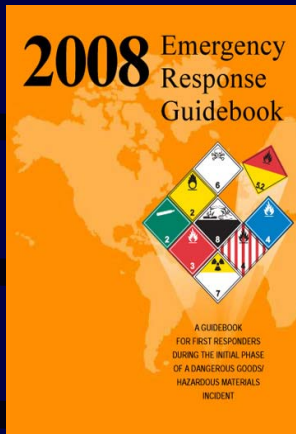


# Ethanol Distribution





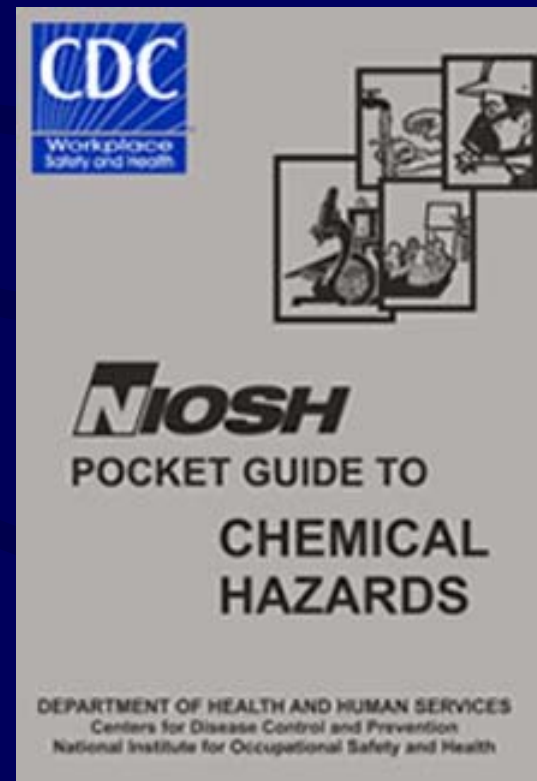
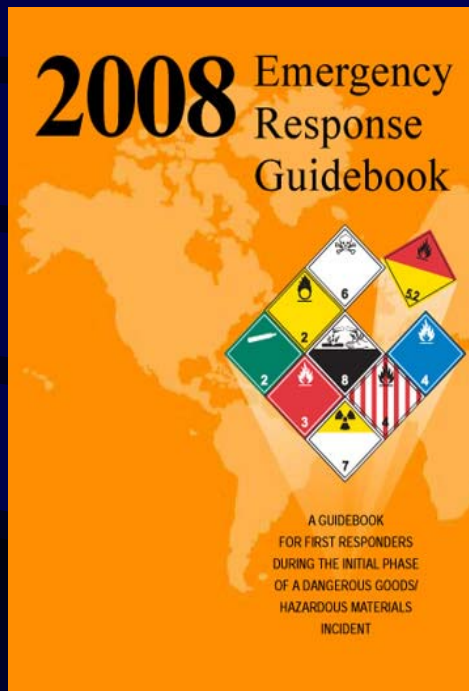
# Hazard & Risk Assessment





# DOT-ERG

## NIOSH-Pocket Guide

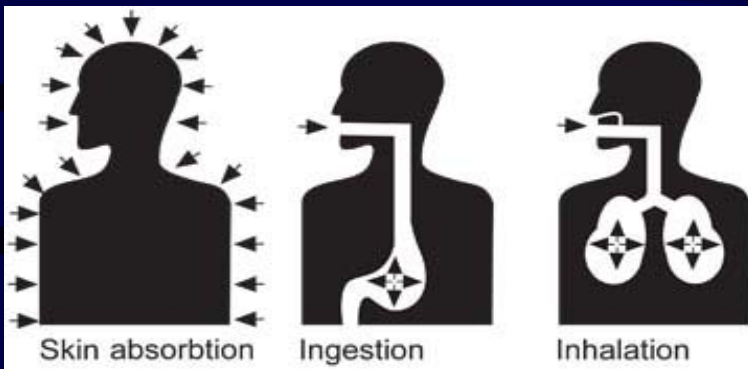




# Ethanol

## Health Hazards

### Human Exposure



### Best Defense





# Placards & Markings

- DOT:
  - Classifies according to primary danger
  - Assigns standardized symbols to identify classes
- Ethanol & ethanol-fuel blends in flammable liquids

September 19, 2008

**SAFETY NEWS**

U.S. Department of Transportation  
Pipeline and Hazardous Materials Safety Administration


**Advisory Guidance:**  
**Emergency Response Involving Ethanol and Gasoline Fuel Mixtures**

The Pipeline and Hazardous Materials Safety Administration (PHMSA) is **alerting emergency responders** to new and revised proper shipping names and identification numbers (ID) that may be used on shipping papers for fuel mixtures composed of ethanol (or "ethyl alcohol") and gasoline in various concentrations. The proper shipping names and IDs are added to the ERG2008.


The following chart is provided as guidance in identifying proper shipping names and identification numbers for Ethanol, Gasoline, and gasoline/ethanol fuel blends. Voluntary compliance began January 28, 2008.

Proper Shipping Name and ID	Ethanol Concentrations
Gasohol, NA 1203	E1 thru E10
Gasoline, UN 1203	E1 thru E10
Ethanol and gasoline mixture, UN 3475	E11 thru E99
Denatured alcohol, NA 1987	E95 thru E99
Alcohols, n.o.s., UN 1987	E95 thru E99
Ethanol or Ethyl alcohol, UN 1170	E100


E10




E85




E95



E100



OR





# Placards & Markings

- Placards able to indicate high-concentration ethanol-blended fuels:
  - Does not distinguish between gasoline & E-10 gasohol
  - E-10 requires AR foam for emergency response

- TRANSCAER

- <http://www.transcaer.com/>





# Ethanol Shipping & Storage Information

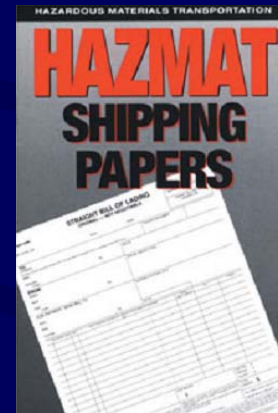


- Sources of information about chemicals involved in spill / fire incidents:

## TRANSPORTATION

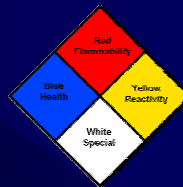


Bill Of Lading-Truck  
Waybill/Consist-Train  
Manifest-Marine Transport



## FIXED FACILITIES

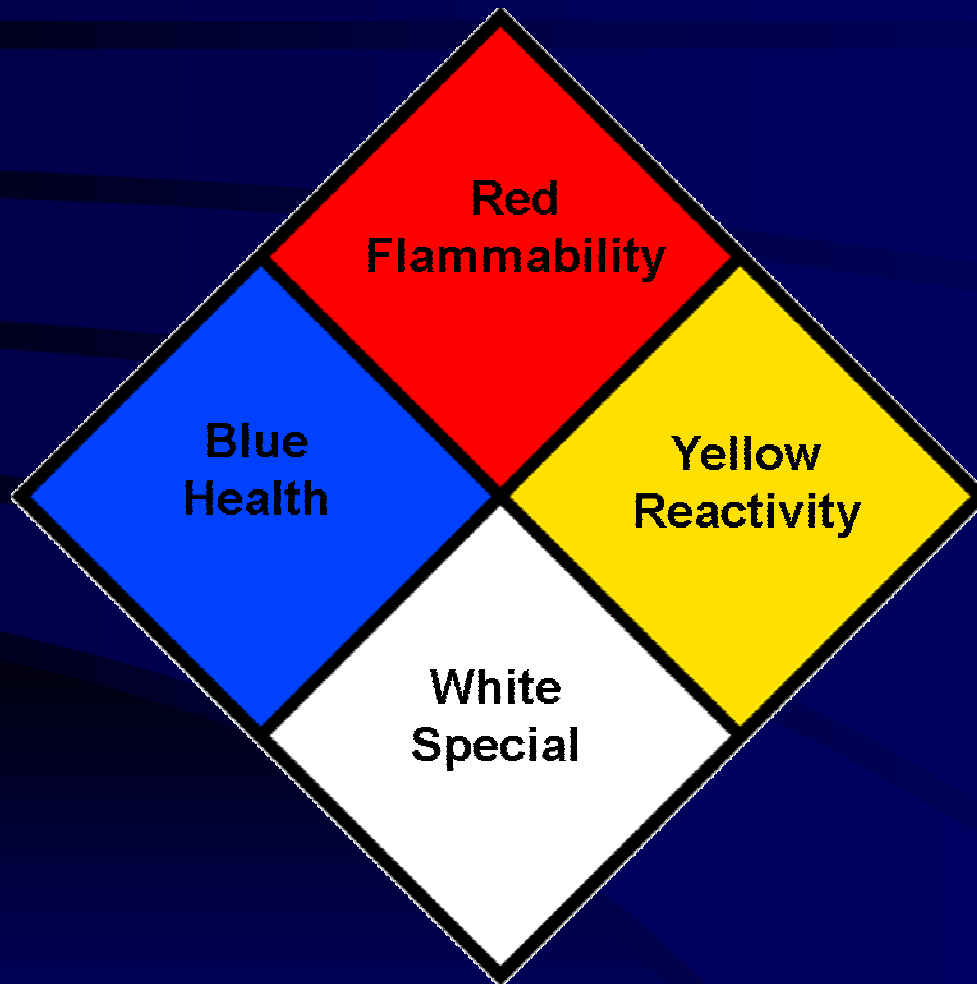
NFPA 704  
Chemtrec  
Product Manufacturer  
Internet



Source: EERC/IAFC/RFA

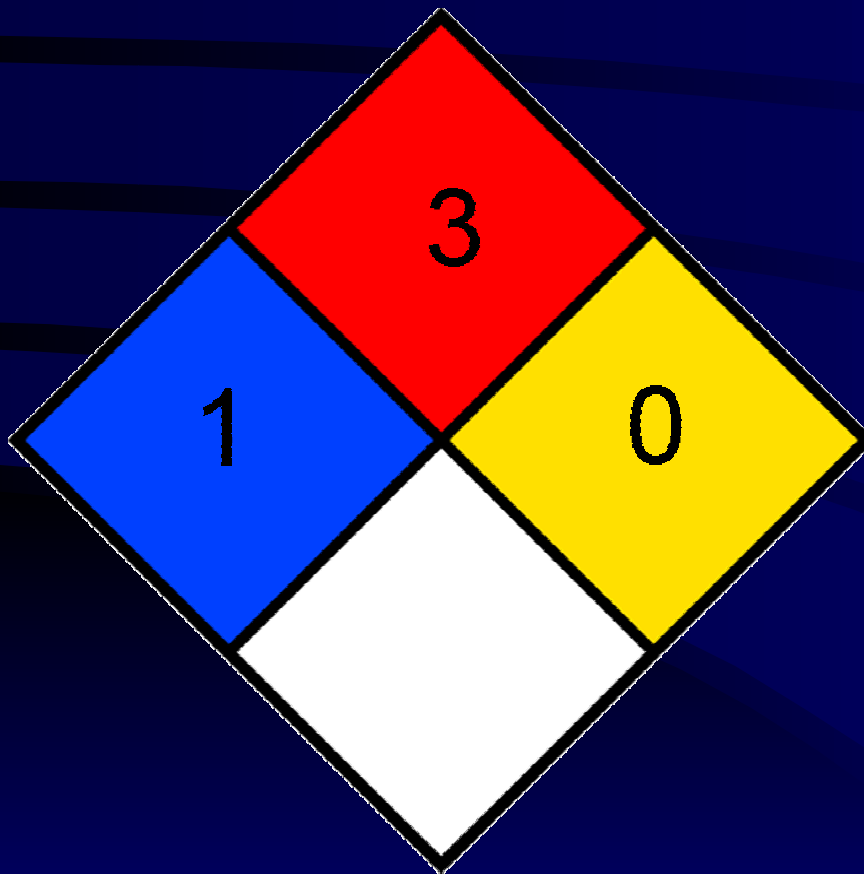


# NFPA 704 Diamond





# NFPA Diamond for E-100, E-95, E-85, and Gasoline



- (1) Minor injury risk  
(skin irritation)
- (3) Can be ignited  
under almost all  
ambient temperature  
conditions
- (0) indicating no hazard



# Ethanol

## The Volume Challenge



Product Transportation



Irving Oil facility, Revere, Mass.

Product Storage Facilities



# Ethanol Transportation



firegeezzer.com



Source: MassDEP MassDFS



# Ethanol Transportation

## ➤ Trains (E-95)

- 2 to 3 trains per week on two routes, one northern, one southern
- Units of 100 railcars, 29,000 gallons each



## ➤ Barges (Everett, Chelsea) E-95

- 19 Million Gallons shipped by barges
- 1 barge per week
- 2.5 million gallons each



## ➤ Tanker Trucks (Highway or Roadway Transportation)

- TC306/DOT 406 Typically carry E10/E85/E95
- TC 307/DOT 407 Typically carry E10/E85/E95
- Up to 12,000 gallons per truck load



Source: MassDEP MassDFS



# A Unit Train Palmer, Massachusetts

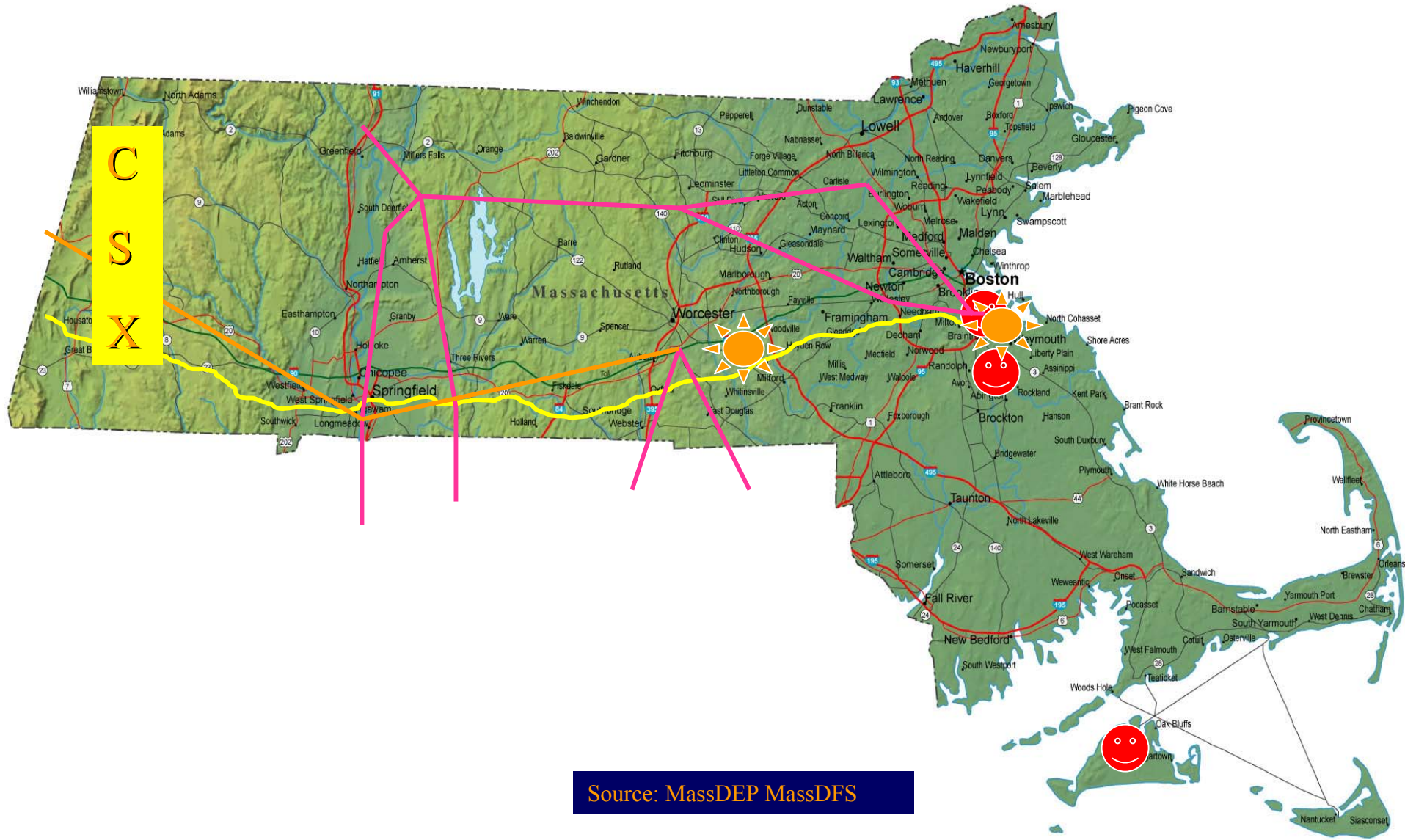
# ETHANOL

A Unit Train May Have 80-100 Rail Cars Of Ethanol

That Train May Stretch 1 Mile Long



# Rail Transport Routes



Source: MassDEP MassDFS



# Ethanol Transportation

## ➤ Commercial & Personal Vehicles

- E10 (Typical gasoline blend)
- E85 (Ethanol Flex Fuel blend)





# Fixed Facilities



Currently 20,606,795 gallons of ethanol in storage in Massachusetts



**Irving Oil facility, Revere, Mass.**



# Fixed Facilities

## ➤ Fixed Facility Storage Tanks

- Some are capable of storing 1 million barrels of fuel
- 1 barrel of fuel = 42 US Gallons



## ➤ Gasoline Stations

- Fuel Pumps
- Underground Storage Tanks (UST)





# Massachusetts First Retail Stations



➤ Massachusetts first E-85 retail gas station

➤ Chelsea

D.K. Burke  
410 Beachem St.  
Chelsea, MA





# Massachusetts Gasoline E-85 Stations

All E85 Stations in Massachusetts Register to Post Prices

City	Station	Address
Chelsea	Chelsea Biofuels Center	410 Beacham Street
Canton	Gulf	683 Turnpike Street
Boston	Gulf Station	100 Service Road
Northampton	Racing Mart	54 Easthampton Rd

- Currently 4 stations in Massachusetts
- 1990 stations in U.S.



# Recent Ethanol Incidents

Source: MassDEP MassDFS

- |                 |                     |        |
|-----------------|---------------------|--------|
| ➤ Oct 07, 2011  | Tiskilwa, Illinois  | Fire   |
| ➤ Jun 14, 2011  | Menlo, Iowa         | Derail |
| ➤ Mar 30, 2011  | Lee, Massachusetts  | Derail |
| ➤ Feb 06, 2011  | Toledo, Ohio        | Fire   |
| ➤ Mar 10, 2010  | Windom, Connecticut | Derail |
| ➤ Jun 19, 2009  | Rockford, Illinois  | Fire   |
| ➤ Aug 23, 2008  | Oklahoma            | Fire   |
| ➤ May 14, 2007  | Baltimore, Maryland | Fire   |
| ➤ Oct 21, 2006  | New Brighton, Penn. | Fire   |
| ➤ June 19, 2006 | Missoula, Montana   | Derail |

Source: EERC/IAFC/RFA



## **JUNE 19, 2006 Missoula, MT**

**Train derails in downtown Missoula, spilling fuel**  
**09:55 AM PDT on Monday, June 19, 2006- Associated Press**



# Massachusetts Incidents

## Gasoline or E10 ?



### [Gas tanker truck crashes in Mass.; driver dies 7-23-2011](#)

SAUGUS — All lanes of Route 1 remain closed in both directions as of 8 am after a tanker truck crashed and exploded early this morning. Read More ...

by [SHTFNEWS](#) | 2 weeks ago | 966 views



### [Everett, Ma fuel tanker rollover](#)

Dec 5 2007 Everett, Ma Firefighters battle flames after a gasoline tanker truck rolled over at the rt 99 rotary, exploding catching several homes ...

by [newsphoto1](#) | 3 years ago | 2,743 views



### [Gas Tanker Crash and Fire](#)

Ride along with Wellesley Police on the way to a gas tanker roll over and fire in Needham on the Wellesley line.

by [WellesleyPDPhoto](#) | 2 years ago | 19,408 views



### [WAREHAM, MA- Gasoline Tanker Tips, Neighborhood Evacuated- Wareham, MA](#)

WAREHAM, MA- A tanker truck carrying 9000 gallons of fuel was left in a precarious position Wednesday after the driver attempted a u-turn up a ...

by [satellitenewsservice](#) | 2 years ago | 3,167 views



# Common Challenges For All Agencies



## ➤ Life Safety

- Immediate
- Short & Long Term Community Health

## ➤ Exposures

- Structures & Critical Infrastructure
- Environment (waterways, water supplies, aquifers)

## ➤ Access to scene (RR-Highway-Fixed Facilities)

## ➤ First Responder Capabilities & Resources

## ➤ Community Resiliency



# Common Challenges For All Agencies



## ➤ Resources

- Manpower (evacuations, fire protection, scene control)
- Equipment (AR-Foam, DC, Nozzles, Eductors)
- Shelter (Staffing, Food, Water, Clothing)

## ➤ Scope/Size of Incident

- Better Plan For A Large Event

## ➤ Multi – Agency Response

- Unified ICS

**Time To Swap Business Cards Is Now**





# Preplanning and Preparedness





# Pre-Incident Planning (Strategy)

- Who Are The Players ? (What are their needs)
  - Fire Rescue
  - HazMat Response
  - Law Enforcement
  - EMS
  - Public Works
  - Utility Companies
  - Local Business Community





# Pre-Incident Planning (Strategy)

➤ Who Are The Players ? (What are their needs?)

➤ DOT

➤ EPA

➤ DEP

➤ MEMA & LEPC

➤ CSX – Pan Am – Providence & Worcester Railways





# Pre-Incident Planning (Strategy)



- Transportation Incident Resources-
- Access-Highway & Railway
- Water Supply
- Fixed Facility
- Foam & Dry Chemical
- Mutual Aid Plan
- Regional Response
  - HazMat
  - DEP
  - EPA
- Training-Full Scale Exercises





# What Is Your Strategy ?



- Examples Of Common Strategies For All Agencies
  - Life Safety and Community Health
  - Public Protective Actions
  - Spill Control (Confinement)
  - Leak Control (Containment)
  - Fire Control
  - Recovery/Resiliency



# Common Strategies For All Agencies



## ➤ Recognize size and scope of incident

- Limited resources, life safety first priority
- Request additional resources

## ➤ Evacuations

- May require the use of all available manpower
- Weather conditions
- Where will they go?





# Common Strategies For HazMat Operations

- HazMat Operations
  - Rescue
  - Environmental Protection
  - Survey Metering (Local & Area Monitoring)
  - Product Confinement/Containment
  - Public Protective Actions
  - Technical Decon
  - Mitigation
  - Recovery Efforts



Source: MassDEP MassDFS



# Common Strategies For Law Enforcement

- Law Enforcement
  - Evacuate
  - Crime Scene
    - Evidence
  - Perimeter Control
    - Scene
    - Traffic





# Common Strategies For EMS

- Fire Rescue-EMS & Trauma Centers
  - Triage
    - Possible MCI
  - Treatment
    - Burn Protocols
    - Assessment of Burn Supplies

"Mass" Decon Unit



**DECON  
BEFORE  
LOADING**



# Common Strategies For EMS

## ➤ Fire Rescue-EMS & Trauma Centers

### ➤ Transport

➤ Trauma Centers /Burn Units

➤ Hospital Surge

### ➤ Trauma Centers/Burn Centers

➤ ICU Beds/Ventilators/Burn





# EMS Issues

- Scene safety is the primary concern for emergency responders
- Depending on location
  - Multi or mass casualty incident (MCI)
- Transportation Routes to hospital and back to scene





# Burns

- There are several ways thermal burn injuries can occur

Direct flame contact  
Radiant heat  
Steam burns





# Blast Injuries



Explosions may result in both blunt force trauma and penetrating injuries

May cause hearing loss

# Blast Injuries

©2008 HowStuffWorks

**1** The blast wave from the explosion creates highly compressed air particles



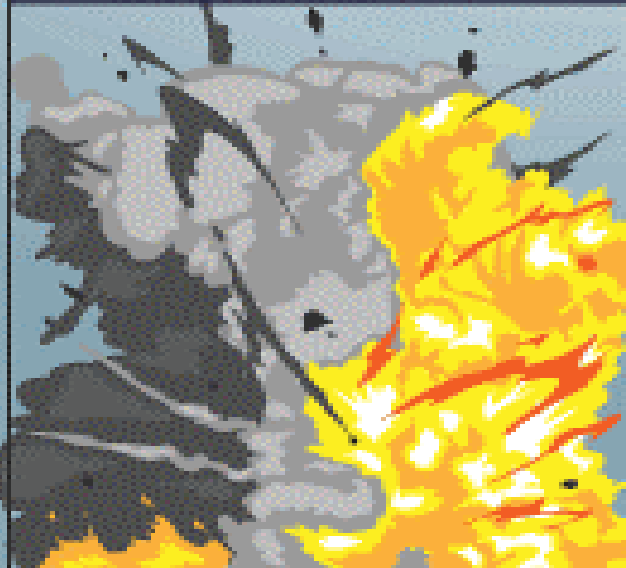
**2** Shockwaves carry energy through the medium



**3** Fragmentation throws shrapnel outward



**4** The explosion creates fire and heat



**5** The intense heat can cause secondary fires or explosions



**6** The blast wind creates a vacuum that refills itself with air and pulls shrapnel back in





# Common Strategies For Environmental Agencies

- Environmental Impacts
  - Historically the product was allowed to burn
  - Exposed soil must be monitored, possibly removed
  - Open water impacts in research

## LARGE VOLUME ETHANOL SPILLS – ENVIRONMENTAL IMPACTS AND RESPONSE OPTIONS

Prepared for:



Source: MassDEP



# Common Strategies For Environmental Agencies

- Ethanol's secondary explosive hazard
  - Biodegrades to methane
    - Time frame up to 15 months after spill
    - 3-8 months concentrations increased
    - 24 months after spill at a depth of 4 Feet concentrations above the LEL were found

Source: MassDEP

## LARGE VOLUME ETHANOL SPILLS – ENVIRONMENTAL IMPACTS AND RESPONSE OPTIONS

Prepared for:  
 **MassDEP**  
Commonwealth of Massachusetts  
Department of Environmental Protection





# Common Strategies For Environmental Agencies

## ➤ Ethanol to Methane

LEL 5% UEL 15%

### ➤ Can be explosive if:

- There is methane gas generation
- It finds a pathway through utility pipes, drains or conduits and
- Collects in a confined space
  - Manhole
  - Subsurface space
  - Utility Room
  - Basement



LARGE VOLUME ETHANOL SPILLS – ENVIRONMENTAL  
IMPACTS AND RESPONSE OPTIONS

Prepared for:



**MassDEP**  
Commonwealth of Massachusetts  
Department of Environmental Protection



Source: MassDEP



# Environmental Impacts

- Waterways
  - Ground Water
  - Aquatic Life
  - Vegetation
- Methane Generation
  - Monitor
  - Mitigate





# Minimize Environmental Impact



- Confinement
  - Dike
  - Damming
  - Booming
- Where do these resources come from?
- How are they restocked?





# Massachusetts DEP Boom Resources-Spill Control





# Common Strategies For Fire Rescue Agencies

## ➤ Fire Rescue Operations

### ➤ Offensive

- Rescue Mode-Protect Egress-Protect Exposures
- Stabilize when manpower, water supply, foam supply permit

### ➤ Defensive

- “Line in the sand” What can/can’t be saved (including us)
- Dike/Dam/Diversion/Vapor Suppression





# Site Management

## “Command Presence”





# Site Management



## **Don't Become Overwhelmed**

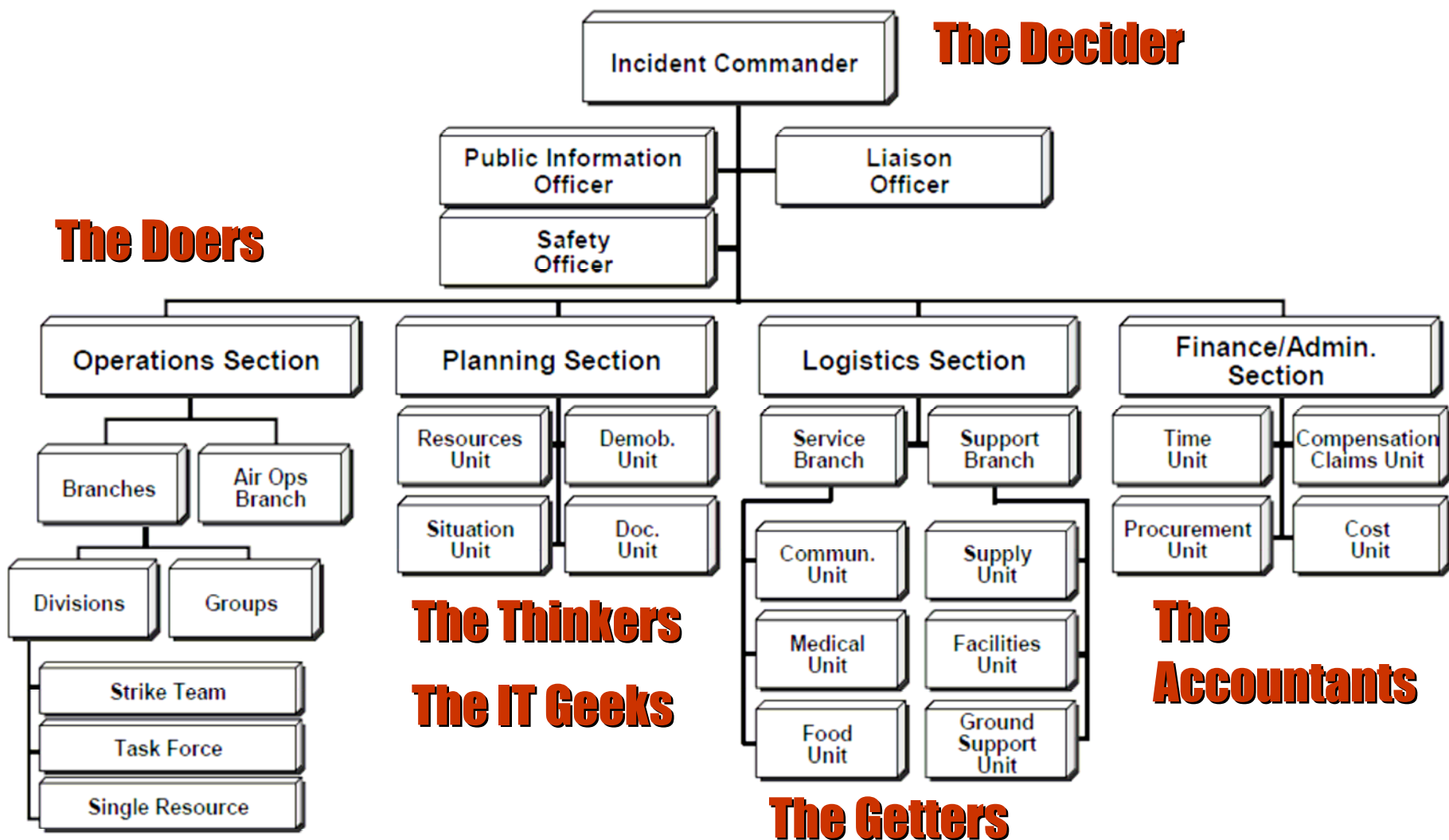


**Establish and Maintain a  
STRONG Incident  
Management System  
(early)**

**USE A UNIFIED ICS  
STRUCTURE**



# ICS-Structure-EOC/FOC





# ICS-Structure Unified Command Works Best !





# “Tactics” Implementing Response Objectives





# What Are Your Tactics ?

- Extinguish or Let It Burn
- Cooling Containers & Exposures
  - Storage Tanks/Railcars/Tankers
  - Structures
- Product Control
  - Diking / Damming / Diversion





# Product Identification

## ➤ What is burning?

### ➤ Read the smoke

- Gasoline
- Gasoline Blend



- Ethanol Blend



### ➤ Read the placard





# What is your GPS ?

## ➤ URBAN

- Life Safety
  - Density
- Exposures
  - Buildings
  - Vehicle Traffic
  - Environment



## ➤ RURAL

- Life Safety
  - Acreage
- Wildland/Terrain
- Access





# Fire Control/Vapor Suppression



Source: TEEX



# Fire Control & Vapor Suppression

## ➤ AR-AFFF

- Alcohol Resistant Aqueous Film Forming Foams

## ➤ Dry Chemical

- Foam Compatibility

**You'll need a lot of it !**





# Fire Control/Vapor Suppression



**Dry Chemical Effective on 3D or Flowing Fuel Fires**

Source: Bill Hand Houston HMRT



# Firefighting Foam



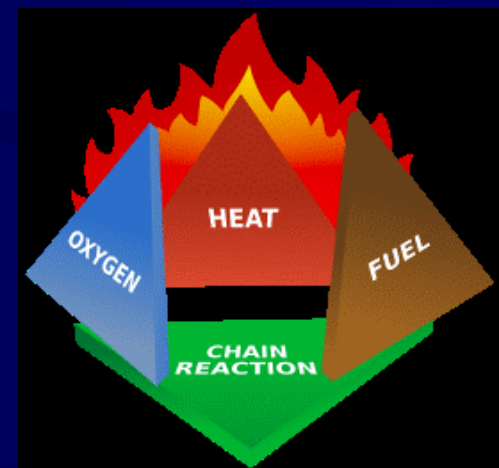


# Basic Foam Principles

## ➤ How foam works:

### ➤ Foam can:

- Exclude oxygen from fuel vapors
- Cool fuel surface with water content of foam
- Prevent release of flammable vapors from fuel surface
- Emulsifies fuel





# Foam Resources

- First Responder & Mutual Aid Apparatus
  - Small Quantities
  - May not be AR-AFFF
  - May not be compatible
  - Nozzles and Eductors mix-matched
- Aircraft Rescue and Fire Fighting Apparatus
  - Typically do not use AR-AFFF
  - Do have Dry Chemical in quantity
    - 750 Pounds
- Regional Foam Trailers





# Massachusetts Regional Foam Resources



Photo by Dan MacAuley [www.firenews.org](http://www.firenews.org)



# Massachusetts Regional Foam Resources



Photo by Dan MacAuley [www.firenews.org](http://www.firenews.org)





# Where Are They ?

## Massachusetts Mobile Foam Resources





# Current Massachusetts Efforts

- SERC Ethanol Committee
- Tri-State Ethanol Exercise
- Coordination of alcohol resistant foam resources by Fire Chiefs Assn. Fire Mobilization Committee
- Department of Environmental Protection “White Paper”
- Department of Environmental Protection on-going Research with CG and NOAA



# The Future

- No end in sight
- Flex Fuel Vehicles will increase the risk
- Pre-eminence of Ethanol will require changes in basic Fire Fighting equipment and training in all communities
- Large environmental incidents will occur.



# Best Practices

- Community Awareness and Conduct Pre-Incident Response Pre-Planning
- Life Safety
- Identify AR-Foam & Dry Chemical Needs
- Evacuate (ERG) and Shelter
- Protect Exposures
  - Structural (Building & Bridges)
  - Wildland
- Protect Environment
  - Contain Runoff, Suppress Vapors & Extinguish burning fuel remaining in containers

